the extreme ends of the framework. As the speed attainable is upwards of 20 knots—developed in a 200-feet run—powerful emergency brakes actuated by hydraulic pressure are provided, in addition to the ordinary friction brakes, and the whole carriage is under perfect control for stopping and starting, and maintaining constant speed during a run.

The extreme length of water surface in the Washington tank is 470 feet, of which about 370 is of the full section across, the remainder being the narrow extremities available for starting and stopping. In order to reduce the time lost between runs through waiting to obtain still water, side troughs 12 inches square in section are laid throughout the length of the tank to absorb the wave disturbance caused by a model run, while at the north end of the tank (Fig. 1) a series of wooden strips placed vertically act as a wave breaker at the close of the run.

Great care is taken to ensure the purity of the water by treating it with alum and filtering through sand

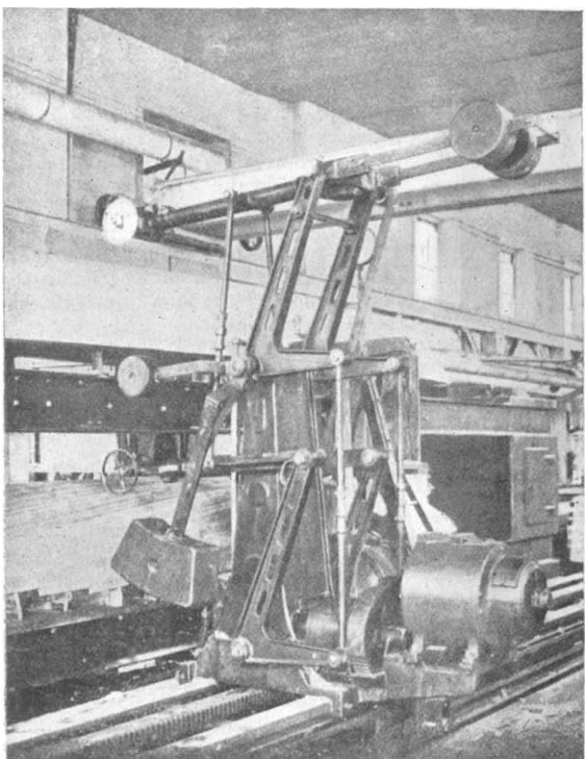

FIG. 4.—Model Shaping Machine.

before admission to the tank. The capacity of the latter is about one million gallons, and the tank can be pumped dry when required in about four hours by a 12-inch centrifugal pump. The temperature in the building is kept as far as possible uniform and slightly above that of an ordinary living room.

A special feature at the Washington establishment is the employment of wood for the models instead of paraffin. This is on account of the heat in summer being too great to allow of the latter material being used, preferable though it is in other respects; for the cost of wood is higher, the difficulties of shaping it to the specified lines are greater, more time is required, and it is, of course, impossible to reduce it to bulk after use, as in the case of paraffin. On the other hand, a wooden model is less liable to accidental damage and retains its shape better if required for future use.

Fig. 3 shows a model being towed through the water, the wave formation being clearly visible; Fig. 4 gives a view of the shaping machine at work on a model.

R. W. D.

VOLCANIC DUST FROM THE WEST INDIES.

IT was mentioned last week that the West Indian mails had brought packets of volcanic dust which fell at Barbados and elsewhere to several institutions and investigators in this country. The characteristics of this material have been minutely examined, and the following descriptions of them will be found of interest.

I.

At the meeting of the Geological Society on Wednesday, May 28, Dr. Flett communicated a preliminary note on the ash which fell at Barbados. The specimens had been forwarded by Dr. Morris, of the Imperial Department of Agriculture, to Prof. Judd, who placed them in the hands of Dr. Flett for examination. The ash consists principally of plagioclase felspar allied to labradorite, hypersthene, monoclinic augite and magnetite. The crystals are often perfectly idiomorphic, and it may be safely inferred that they were formed in the magma before the actual eruption took place, and blown into the air along with the molten material by the force of the escaping gases. A small amount of glass containing steam holes is adherent to some of the crystals, but many are perfectly clean.

The crystals are similar in every respect to the phenocrysts of hypersthene-augite-andesite, a type of rock well known among the recent volcanoes of the Pacific region. In the discussion which followed the reading of Dr. Flett's paper, it was pointed out by Mr. Prior that the same type of rock occurs in other West Indian islands, and also in the Mexican volcanoes, so that the petrographical evidence serves to connect the West Indian volcanic region with the Pacific rather than with the Atlantic. An analysis of the ash by Dr. Pollard was communicated by Dr. Flett. It is quoted below.

SiO_2	52·81	MgO	5·19
TiO_2	·95	K_2O	·60
Al_2O_3	18·79	Na_2O	3·23
Fe_2O_3	3·28	P_2O_5	·15
FeO	4·58	SO_3	·33
MnO	·28	Cl	·14
(CoNi)O	·07	H_2O 105°	·20
CaO	9·58	H_2O above 105°	·17
		Total	100·35

It must be remembered that this analysis does not represent the composition of the material as it existed in the subterranean reservoir immediately before the eruption, but rather the bulk analysis of the crystals which had separated out, together with only a small admixture of the glass.

If this glass could be separated and analysed it would probably be found to differ from the bulk analysis of the crystals in the same way as the glassy base of hypersthene-andesites differs from the bulk analysis of the phenocrysts; that is, it would contain more silica, less lime, iron and magnesia, and more alkalis, especially potash. In Old Red Sandstone times the volcanoes of the Cheviot district erupted hypersthene-andesites, and the glassy base of one of these rocks was analysed by Dr. Petersen with the following result:—

SiO_2	66·25	MgO	·28
Al_2O_3	13·59	K_2O	4·95
Fe_2O_3	3·11	Na_2O	2·25
CaO	2·75	H_2O	5·89
		Total	99·07

The samples of ash from Barbados hitherto examined consist mainly of the crystals. The glassy matter which represents the mother liquor appears to have been vanned away and deposited elsewhere. This, if it should turn out to be the case, is somewhat unfortunate, for the glass, with its higher percentage of potash, would have been more useful as a fertilising agent.

J. J. H. TEALL.

II.

The photographs here reproduced are those of the volcanic dust which fell in Barbados on Wednesday, May 7. The circumstances attending the fall have been so graphically described in a letter, dated May 10, from Mr. G. C. Edghill, the manager of the sugar plantation on which the dust fell, to its owner, Captain Forte, that it seems best to quote parts of the letter *verbatim*. It is to the kindness of Captain Forte (a friend of my father's) that I owe both the letter and the specimen of the dust.

Mr. Edghill writes as follows :—

"Wednesday morning, May 7, opened normally, the day being fine and a steady breeze blowing. Soon after mid-day we began to hear deep subterranean explosions, increasing in intensity, some single, others in volleys of about five or six. Some of these made the earth vibrate like a slight shock of earthquake, and they continued for two or three hours. Then a black cloud began to rise in the direction of St. Vincent, which rose and spread towards and around us, *although the wind was blowing from us towards it.* (The italics are mine.)

"About four o'clock the edge of this cloud began to obscure the edge of the sun, and dust began to fall, at first lightly, but increasing gradually in volume, and making a noise like a fine drizzle. Rapidly then the light grew dim, and the appearances were like those of a total eclipse of the sun, but very grand and startling—making one feel creepy. At five o'clock it was quite dark, and our mill hands had to be lent a lantern to see their way home. At six o'clock it was as dark as midnight, and we went to bed as usual, the only disturbance in the night being incessant thunder and lightning in the direction of the mountain. . . . When the daylight came it was alarming to see everything covered by a layer of dust a quarter of an inch thick. I say a quarter of an inch, because I put out a dinner plate on the lawn above the house when the fall began, and the next morning the dust lay a quarter of an inch thick on it. All the green had given place to a light brown, and the canes had almost quite disappeared. . . . I forgot to mention that the dust was cool and smelling strongly of brimstone. It is estimated that upwards of fifteen tons per acre fell on the island. . . ."

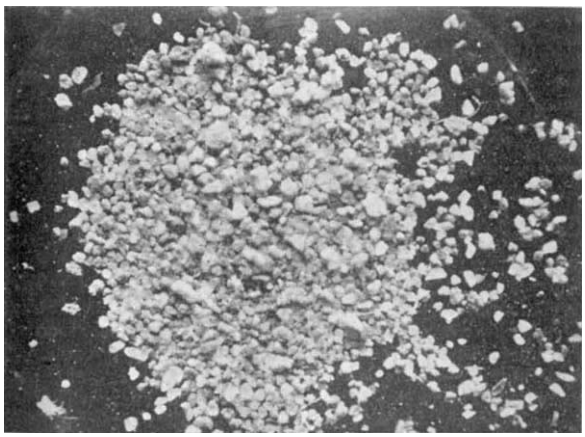

FIG. 1.

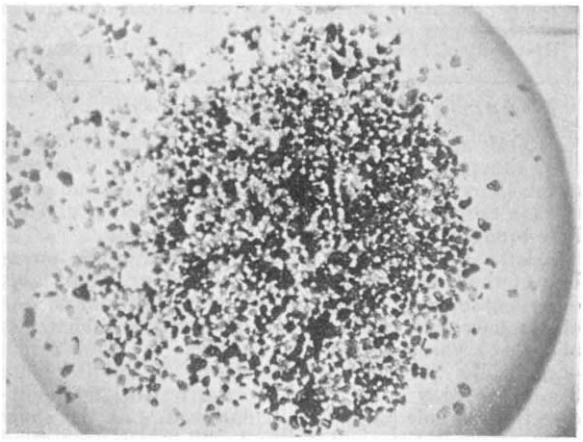

FIG. 2.

To turn to the two photographs, which show the dust magnified exactly seven and a half diameters (or about 56 times in area). Fig. 2 is precisely the same view of the same dust particles as those seen in Fig. 1, except that the light comes through them in Fig. 2 whereas it is shining down upon them in Fig. 1. In other words, Fig. 1 is by reflected light, but Fig. 2 by transmitted light ; Fig. 2 therefore shows clearly which particles of the dust are transparent and which opaque ; and it is very instructive carefully to compare Figs. 1 and 2. It will be seen at once what a very large proportion of the particles are transparent—more than two-thirds, in fact. Most of the opaque particles are very strongly magnetic, and are certainly magnetic oxide of iron (they are not titaniferous iron, still less hæmatite). But these are mixed with others, also attracted by the magnet, but far less so, apparently of a dark-coloured mica. The mean size of these dark particles is about 0·008 cubic millimetre. When thrown into water, about half the powder sinks at once, and if the floating particles be examined with a high power, it will be seen that they are all buoyed up by air bubbles ; on violently agitating the dust with the water, the dust sinks, so that it does not seem to contain any of the *lighter* kinds of pumice, which through their extremely porous nature cannot be made to sink so easily.

When the dust is thrown into a solution of density 2·52 (a solution of mercuric iodide in potassium iodide), about one-fifth of its particles float ; these are larger and lighter in colour than the rest, and under the microscope have the appearance of a yellowish-brown semi-transparent glassy material, with bubbles in it, and numerous fine air tubes running through its substance all more or less in one direction ; moreover, it shows evident signs of fusion on its surface, and is no doubt a rather heavy kind of pumice ; along with these particles are some of a clear greenish glass, full of cavities *which do not act on polarised light*—they are transparent obsidian or true volcanic glass. Of the particles which sink in the double iodide solution, those of black, metallic-looking magnetite have already been mentioned, and also the dark-coloured mica ; with these there are remarkably perfect crystals of a felspar, some of which contain cavities of a regular geometrical shape. These crystals have curiously retained in many instances the primitive sharpness of their edges. Probably a sodium felspar is present, as well as the potassium compound, for the ash, after digestion with pure ammonium fluoride, leaves a residue giving a brilliant and long-lasting yellow colour to a Bunsen flame, and with a spectroscope, the lines of potassium and calcium are brilliantly shown as well as the double sodium line. There are also in the ash a considerable number of splintered crystals, of conchoidal fracture, and hard enough to scratch glass, which, like all the crystals present in this ash, act powerfully on polarised light ; they are quartz, and the edges of most of these particles are blunt and the corners visibly rounded. There are also a large number of transparent crystals of a brownish-green colour, very well preserved in form, which a rather hasty examination would indicate as olivine, but of this I do not feel quite sure. The residue after the ammonium fluoride treatment proved to consist chiefly of compounds of iron, calcium and magnesium ; there is a trace of some metal present which forms a sulphide insoluble in hydrochloric acid, but what it is I could not determine, the total quantity of ash at my disposal being only 1·304 grams. Perhaps it is copper—whatever it may be, it is only present in very minute quantity. Magnesium is present in considerable quantity, almost certainly as a silicate. There is more than a trace of manganese, and aluminium is also present, but only in very small amount. Barium and strontium compounds are absent. The dust, when heated carefully in a hard glass tube, gives off a trace of water, which it appears to hold mechanically, and afterwards yields a slight crystalline sublimate, probably of some ammonium compound (? the chloride). No sulphur could be certainly detected, in spite of the strong sulphurous smell which, it seems from the account, the dust had

when it fell, and which points to the ashes having been accompanied by an invisible cloud of sulphur dioxide on their emission from the crater, so that they mechanically occluded some of the gas. The ash gave no effervescence with a powerful acid, the action of the acid being closely watched under the microscope,[1] so that carbonates, such as limestone, and ammonium carbonate seem entirely absent. Finally, the drift of the ash against the wind will have been already noticed. This was due, one would naturally suppose, to the existence of a contrary upper current of air into which the ashes were projected, as they were, indeed, in the great eruption of 1812, when, in spite of the N.E. wind blowing strongly at the time, the ashes fell on the Azores, some hundreds of miles eastward of La Soufrière of St. Vincent.

Eton, Bucks, May 27. T. C. PORTER.

III.

The dust from the Soufrière, which fell in Barbados on May 7 and 8, appears to be composed of fragments of glassy and pumiceous lava, broken crystals of plagioclase felspar, augite and hypersthene, much magnetite, often in perfect octahedra, and a very few crystals of brown hornblende. The felspars range in specific gravity from labradorite to anorthite. Hypersthene is the predominating coloured silicate.

Dust from the eruption of 1812 also collected in Barbados is of much finer grain, but evidently composed of the same minerals with the green augite in smaller proportion.

The magma appears to have been of the nature of hypersthene-andesite, a rock exceedingly common among the recent lavas of American volcanoes. Further, the magma seems to have remained practically unchanged in composition during the Soufrière's ninety years of dormancy.

University of Edinburgh. J. D. FALCONER.

RECORDS OF RECENT ERUPTIONS.

FROM accounts which have been published during the past week, some additional details referring to the character and effects of the recent volcanic eruptions in the West Indies have become available and are here brought together.

A letter from Mr. A. D. Whatman, one of the members of the Government relief expedition to Martinique, describes some of the events as related to him by one of the survivors of the steamship *Roraima*, which was about 150 yards from the shore when the catastrophe occurred at St. Pierre. It appears that a little before 8 a.m. on May 8 an explosion was heard, and immediately the whole place was in darkness. At the same moment white-hot sand began to fall, which penetrated everywhere like snow, and immediately killed everyone on deck. After about an hour and a half the fall of white-hot ash stopped.

Referring to the condition of St. Pierre when he visited it, Mr. Whatman says :—

There was no lava thrown out; nothing but this fine sand, which was evidently white hot. Judging from what the few saved said and from what I myself saw and could judge from the position of the bodies, I have little doubt that everyone who was not under cover at the time the sand began to fall was killed in less than two minutes. The rest must have survived for a very short time longer, as they must have been quickly suffocated by the heat from the falling sand, not to mention the fact that the whole town must have caught fire at the same moment. A tremendous blast of air must have crossed from north to south, as all trees have been uprooted, and their remains are all pointing with roots towards the volcano. The lighthouse also fell in the same direction.

A message from the Acting Governor of Martinique states that from the further exploration of St. Pierre it would seem as if the southern portion of the town was destroyed by an as yet unexplained phenomenon, which acted with lightning-like rapidity, and has left traces as of a violent storm sweeping from north to south. The rain of ash which preceded, accompanied and followed this phenomenon covered the surface of the land to a depth of between twenty-five and thirty centimetres. The northern part of St. Pierre is buried beneath a mass of mud.

From the *Observer* we learn that the Deputy-Mayor of St. Martinique, who left St. Pierre just fifty minutes before the catastrophe took place, and was a witness of all the circumstances which led up to it, has given a new account of the condition of the volcano before the eruption. He says that shortly before St. Pierre was overwhelmed, immense fissures, caused by the earthquake, appeared in the side of Mont Pelée, reaching down to the edge of the sea. Into these the sea water rushed, and it was the contact between the water and the burning lava from the volcano which caused Mont Pelée practically to blow up like an overheated boiler.

The *Standard* records some observations made by Prof. R. T. Hill, a member of the United States Geological Survey, who went with Prof. Heilprin to Martinique to observe the volcanic phenomena and effects. Prof. Hill made his observations at a distance of five miles from Mont Pelée. On May 26 he observed what is usually described as lightning playing through the mushroom-shaped cloud overhead, like a sheet covering the country up to ten miles from the crater. These flashes occurred with alarming frequency, and they followed distinctly horizontal paths, hence they are believed to be effects produced by the explosive combustion of gases leaving the Mont Pelée crater.

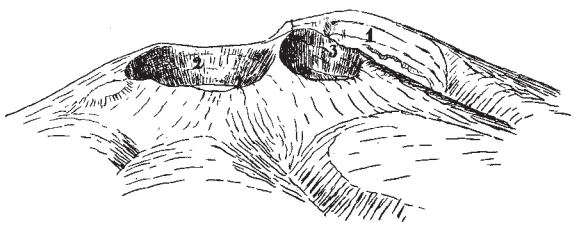

FIG. 1.

Mr. G. Kennan, who reached the new crater near Ajoupabouillon, at the head of the river Falaise, which is boiling hot, reports that a large section of the side of Mont Pelée has fallen, leaving a huge perpendicular cliff, in which there are five immense tunnels or cavities.

Dr. Hans Reusch, director of the Geological Survey of Norway, has sent us the following description of the crater of the Soufrière of St. Vincent as he found it in 1892 :—

During a visit to the West Indies in 1892 I ascended the volcano now so much spoken of on the northern end of St. Vincent. When I was at the top I drew the accompanying bird's eye view from the south (Fig. 1).

It may be of some interest to compare this with the changes which undoubtedly have taken place during the recent eruptions. The crater numbered 1 is the remnant of an old very wide crater—some kind of Monte Somma (of Vesuvius). The height is given on the maps as 4043 feet above the sea. No. 2 is "the big crater," the breadth of which I estimated to be 1 kilometre. The bottom is filled with a lake of bluish-green opaque water, the colour being due to sulphur in fine powder. I calculated the vertical distance from the lake to the lowest point of the brim to be about 150 metres. The dip of the inner sides of the crater was about 60°. The slopes were mostly covered with bushes, but a stratification of the tufa was marked by horizontal lines. The small crater, No. 3, is about half as large as the other one, but comparatively deep. The stratification of its sides is inclined at about 20° in a northerly direction. It is a "steam hole" blown out somewhat to the side of the chief place of eruption. On the bottom lies a little pond of clear water, the rest of the bottom being covered with loose material washed down from the sides of the crater. The only sign of volcanic activity was a little smoke now and then

[1] One opaque crystal only seemed to evolve a slow stream of bubbles, as if they came from a cavity in it. Whatever the gas was it dissolved in the liquid very rapidly, the bubbles visibly diminishing almost to nothing in ascending through the very shallow stratum of liquid above the crystal.